

7.2 Writing Expressions and Equations

Learning Objectives

- I can write addition and subtraction phrases as single-variable expressions.
- I can write multiplication and division phrases as single-variable expressions.
- I can write sentences as single-variable equations.
- I can model real-world situations with simple equations.

Introduction

The Class Trip to the Amusement Park

Mrs. Hawk's sixth grade class is going on a final class trip to Valleyfair, the amusement park. While it will be a lot of fun, the amusement park also incorporates math and science activities into their park, so there will be some educational components to the trip as well. The students are really excited! Not only are they almost seventh graders, but they will get to finish a terrific year with a fun trip.

Valleyfair is about two hours away, so Carl offers the class an idea to take a big greyhound bus instead of the typical school bus. The problem is that it costs a lot more to take a greyhound bus than the typical school bus.

"How much will that cost?" Sarah asked after Carl presented the idea.

"I don't know, but it would be a lot more comfortable. The amusement park ticket is \$14.50 per person. We could add the cost of the bus to that," Carl suggested.

"That could get pretty expensive. I would like the total expense for each student to be \$20.00," Mrs. Hawk chimed in. "Why don't you investigate costs and get back to us?"

Carl agrees to do this. On his paper he makes a few notes.

\$14.50 Valleyfair ticket

Bus cost unknown



Bus cost per person unknown

Total cost per person \$20.00

Carl is puzzled on how to tackle this problem from here. He will need to write an expression and an equation to figure this out. In this lesson, you will begin learning all about expressions and equations and how useful they can be in real-life situations. Pay close attention and you will be able to help Carl at the end of this lesson.

Guided Learning

Write Addition and Subtraction Phrases as Single-Variable Expressions

A variable expression is a type of expression. First, let's review what we mean by the word "**expression**".

What is an expression?

An **expression** is a combination of variables, numbers and operations without an equals sign. An expression can have changeable parts to it. The variables in an expression can have different values. Therefore, we evaluate an expression, we don't solve it. That is the reason why there isn't an equal sign with an expression.

What is a variable?

A **variable** is a letter used to represent an unknown quantity.

Notice that variables are a part of an expression. You have already learned how to evaluate expressions when you have been given a value for the variable. Let's look at an example.

Example A

Evaluate $3x + 1$ when $x = 4$

To figure this out, we substitute the four in for x and then evaluate the expression.

$$3(4) + 1$$

$$12 + 1$$

$$13$$

The answer to this problem is 13.

In this example, the expression was given to you. Someone else wrote the expression. Now it is time for you to learn how to write an expression from a phrase.

How can we write an expression from a phrase?

We can write expressions to represent different situations. To write an expression, you will need to pay attention to key words which identify different operations, unknown variables and numbers. When you

have identified these things, you will be able to write variable expressions from phrases.

Today, we are going to start by writing expressions involving addition and subtraction.

Let's look at an example.

Example B

Five more than an unknown number

First, we break down this phrase. Identify the numbers involved. The only number involved here is the number five.

5

Next, we look for an operation. "More than" is a key word that means "add," so our operation is addition.

+

Finally there are the words "an unknown number." An unknown number is represented by a variable. In this expression, we can use the letter x .

Now we can put it all together.

$$5 + x$$

To write expressions from phrases, you will need to work like a detective. You have to decipher the meaning of the words in the phrase and then put the pieces of the puzzle together by writing the expression.

Key words help you in identifying which operation is involved in the expression. Let's look at some key words that mean addition and subtraction.

Addition

Sum, plus, altogether, and

Subtraction

Difference, less than, subtract, take away

Let's look at another example.

Example C

Nine less than an unknown quantity

First, let's look for the numbers in this phrase. The only number here is the number nine.

9

"Less than" means subtraction.



Finally, we have the words “unknown quantity” and so we use a variable. Let’s use the variable y .

Now we can write the expression. Notice that we have 9 less than an unknown quantity so we write the variable first, then the subtraction symbol and finally the number 9.

The answer is $x - 9$.

Guided Practice

Practice writing expressions from the following phrases.

1. An unknown number and four
2. The difference between ten and an unknown number
3. Seven less than a number



Take a few minutes to check your answers with a partner. Did you write the expression correctly?

Solutions

1. $x + 4$
2. $10 - x$
3. $x - 7$

Write Multiplication and Division Phrases as Single-Variable Expressions

In the last section, you worked on writing addition and subtraction phrases as variable expressions. In this section, you will write multiplication and division phrases and single-variable expressions.

Let’s start by looking at some of the key words that mean multiplication and division.

Multiplication

Product, times, groups

Division

Split up, quotient, divided

When deciphering phrases, you will be looking for the same things as the last section.

1. Identify any numbers
2. Identify the operation involved
3. Identify the variable

Let's look at an example.

Example D

The product of eight and a number

First, identify any numbers. The number in this phrase is eight.

8

Next, identify the operation. The word "product" means multiply.

$\times$

Finally, identify the variable. "A number" means use a variable.

y

Next, we write the expression.

$8y$

Remember that a number next to a variable means multiply. We could also have used parentheses to show multiplication.

Helpful Hint!

When working with variables, it is better not to use the x to represent multiplication because it can be mixed up with a variable.

Now let's look at a phrase with division.

Example E

Twenty-four divided by a number

First, identify any numbers.

24

Divided $\div$

A number means use a variable y

Now put it all together to write an expression.

$$24 \div y$$

We could also use a fraction bar to show division.

$$\frac{24}{y}$$

Guided Practice

Practice writing expressions from the following phrases.

1. Six times an unknown number
2. An unknown number divided by two
3. The product of seven and a number



Check your answers with a partner.

Solutions

1. $6(x)$
2. $x \div 2$
3. $7(x)$

Write Sentences as Single-Variable Equations

The last section focused on writing expressions. Remember that an expression contains some combination of numbers, variables and operations, but does not have an equals sign. When you have an equals sign, you have an **equation** not an expression.

An equation has an equal sign. One side of the equation equals the other side of the equation.

Let's look at an example.

$$5 + 9 = 14$$

Here five plus nine is equal to fourteen. The quantity on one side of the equal sign is the same as the quantity on the other side of the equal sign. You have been solving equations for a long time.

What about equations with a variable in them?

You can also have equations with variables in them. **When you have a variable in an equation, there is an unknown quantity.** With an expression, there was not an equal sign. With an equation, one side will equal the other side.

Let's look at an example.

Example F

Five plus an unknown number is equal to fifteen.

To write an equation for this phrase, we start by working our way through the problem from the left to the right.

The first part is 5

"Plus" means addition

"An unknown number" is the variable

"Is equal to" is our equal sign

"Fifteen" is 15

Let's write it out.

$$5 + x = 15$$



Yes you can. You have to pay attention to the key words, but once you have the keywords, then you can write a single-variable equation.

Let's look at another example.

Example G

Six less than a number is equal to ten.

The first number is 6.

"Less than" means subtraction, but be careful. Since this is "six less than" the order is reversed.

"A number" is the variable

"Is" means equals

"Ten" is 10.

Now let's put it all together.

$$x - 6 = 10$$

Here is an example that uses multiplication.

Example H

The product of three and a number is thirty.

"Product" means to multiply

"Three" is 3

"A number" is our variable.

"Is" means equals

Thirty is 30

Put it altogether.

$$3y = 30$$

As long as you walk through each written phrase carefully you will be able to write equations to match. Stay tuned, in another lesson you will learn how to solve equations!

Guided Practice

Practice writing single-variable equations for each phrase.

1. Fifteen divided by an unknown number is three
2. Six times an unknown number is thirty-six
3. Fifteen and twelve is an unknown number.



Please check your work with a partner.

Solutions

1. $15 \div x = 3$
2. $6x = 36$
3. $15 + 12 = x$

Real Life Example Completed

The Amusement Park

Let's look at the original problem once again. Reread the problem and underline any important information.

Mrs. Hawk's sixth grade class is going on a final class trip to Valleyfair, the amusement park. While it will be a lot of fun, the amusement park also incorporates math and science activities into their park, so there will be some educational components to the trip as well. The students are really excited! Not only are they almost seventh graders, but they will get to finish a terrific year with a fun trip.

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“That could get pretty expensive. I would like the total expense for each student to be \$20.00.” Mrs. Hawk chimed in. “Why don’t you investigate costs and get back to us?”

Carl agrees to do this. On his paper he makes a few notes.

\$14.50 Valleyfair ticket

Bus cost unknown

Bus cost per person unknown

Total cost per person \$20.00

First, Carl needs to write an expression to represent the situation. He can use the cost of the amusement park ticket plus the unknown bus cost per person. Because the bus cost per person is unknown, Carl will first need to figure out the total cost of the bus divided by the number of people in his class. There are 26 students in Carl’s class.

$x = \text{total cost of bus}$

26 students in class

$\frac{x}{26} = \text{the cost per person for the bus} = y$

Next, Carl can take the cost per person for the bus, y , and add that to the price of the amusement park ticket.

$\$14.50 + y$

Carl’s teacher has said that she wants the total to be \$20.00 per person. Now Carl has enough information to write an equation.

$\$14.50 + y = \20.00

Now that Carl has written a couple of equations, he can complete some research on bus costs and figure out the cost of the trip for each person in his class. Stay tuned, Carl will need to learn how to solve equations to accomplish his task. Solving equations is coming up next!

Review

- Identify the parts of your problem, then write an expression or equation to solve it.

Expression

A variable expression has variables or unknown quantities, numbers and operations without an equal sign.

Equation

A variable equation has a variable, numbers and operations with an equal sign.

Variable

A variable is a letter used to identify an unknown quantity.

Additional Resources

[Introduction to Variables and Variable Expressions Video](#)

[Defining Variables Video](#)

[Writing Variables Expressions Video](#)

[Writing Basic Algebraic Expressions Video](#)

[Writing Basic Algebraic Expressions Video 2](#)